IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent application of:

Applicant(s):	Kai Numssen et al.
Serial No:	10/684,811
Filing Date:	October 14, 2003
Title:	METHOD FOR MANUFACTURE OF A HIGH TEMPERATURE SUPERCONDUCTING LAYER
Examiner:	Talbot, Brian K
Art Unit:	1762
Docket No.	BARDP0124US

APPEAL BRIEF

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

The undersigned submits this brief for the Board's consideration of the appeal of the Examiner's decision, mailed October 10, 2007, finally rejecting claims 1-10 of the above-identified application.

The fee for filing an appeal brief is being paid concurrently herewith. In the event an additional fee is necessary, the Commissioner is authorized to charge any additional fee which may be required to Deposit Account No. 18-0988 under Docket No. BARDP0124US.

I. Real Party in Interest

The real party in interest in the present appeal is Theva Dünnschichttechnik GmbH.

II. Related Appeals and Interferences

Neither appellant, appellant's legal representative, nor the assignee of the present application are aware of any appeals or interferences which will directly affect, which will be directly affected by, or which will have a bearing on the Board's decision in the pending appeal.

III. Status of Claims

Claims 1-10 have been finally rejected and claim 11 has been cancelled. Claims 1-10 are the claims on appeal, and a correct copy of these claims is reproduced in the Claims Appendix.

IV. Status of Amendments

No amendments have been filed subsequent to the issuance of the Office Action dated August 30, 2007, from which this appeal is taken. A request for reconsideration was filed but the rejections have been maintained.

V. Summary of Claimed Subject Matter

The following is a concise explanation of the subject matter defined in each of the independent claims involved in the appeal, which refers to the specification by page and line number in brackets, and to the drawing by reference characters.

Claim 1

1. A method for the manufacture of a high temperature superconducting layer on a substrate comprising the following steps:

a. deposition of an $RBa_2Cu_3O_7$-layer onto the substrate (1a) with a low growth rate less than 1 nm/s, wherein R represents yttrium, an element of the group of rare-earth elements (atomic number 57-71) or mixtures of two or more of these elements [5/14-17; 8/1-9];

b. deposition of an $XBa_2Cu_3O_7$-layer (3) onto the $RBa_2Cu_3O_7$-layer (2) with a high growth rate greater than 1 nm/s, wherein X represents yttrium, an element of the group of rare-earth elements (atomic number 57-71) or mixtures of two or more of these elements [5/17-20; 8/11-16].

VI. Grounds of Objection/Rejection to Be Reviewed on Appeal

A1. Claims 1-10 stand finally rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,943,136 (referred to herein as "*Kwon*") in view of U.S. Patent No. 6,899,928 (referred to herein as "*Groves*").

A2. Claims 1-10 stand finally rejected under 35 U.S.C. § 103(a) as being unpatentable over *Kwon* in view of U.S. Patent No. 5,248,649 (referred to herein as "*Nagaishi*") and *Groves*.

A3. Claims 1-10 stand finally rejected under 35 U.S.C. § 103(a) as being unpatentable over *Kwon* in view of U.S. Patent No. 6,177,135 (referred to herein as "*Hintermaier*") and *Groves*.

VII. Argument

The rejections advanced by the Examiner are improper and should be reversed for at least the following reasons.

A1. Rejection of Claims 1-10 (*Kwon* with *Groves*)

Claims 1-10 stand finally rejected under 35 U.S.C. § 103(a) as being unpatentable over *Kwon* in view of *Groves* or *Nagaishi*. The Examiner's remarks in support of the rejection are as follows:

> Kwon et al. (6,943,136) teaches a superconducting structure whereby a superconducting buffer layer is applied to a substrate followed by another superconducting layer. Both the superconducting layers can be of the type ReBCO. Rare earth elements (Re) include samarium, neodymium, gadolinium, europium etc. The substrate can include a buffer layer prior to the superconductor buffer layer. The superconducting buffer layer can be from 5-50 nm in thickness. The rate of formation can be varied between 0.1 to 200 A/s by changing the repetition rate of the laser or the divergence (abstract and col. 2, line 10 – col. 4, line 60).
>
> Kwon et al. (6,943,136) while teaching changing the rate of formation is known, fails to teach changing the rate of formation from low to high.

(a) Groves et al. (6,899,928) teaches depositing buffer layers and YBCO layers. The buffer layers are applied with a growth rate of 0.5 nm/s followed by the YBCO layer having a growth rate of 2.0 nm/s to obtain improved lattice matching with the final YBCO layer(col. 6, lines 4-18).

Therefore it would have been obvious for one skilled in the art at the time the invention was made to have modified Kwon et al. (6,943,136) process by slowing down deposition of the superconducting buffer layer as evidenced by the Groves et al. (6,899,928) with the expectation of achieving a higher quality buffer film which would in turn produce a higher quality superconducting film thereon based upon the crystallographic structure of the buffer film being continued throughout the superconducting layer.

<u>Claim 1</u>

Claim 1 recites a method for the manufacture of a high temperature superconducting layer on a substrate. The method comprises the steps of:

a. deposition of an $RBa_2Cu_3O_7$-layer onto the substrate with a low growth rate less than 1 nm/s, wherein R represents yttrium, an element of the group of rare-earth elements (atomic number 57-71) or mixtures of two or more of these elements;

b. deposition of an $XBa_2Cu_3O_7$-layer onto the $RBa_2Cu_3O_7$-layer with a high growth rate greater than 1 nm/s, wherein X represents yttrium, an element of the group of rare-earth elements (atomic number 57-71) or mixtures of two or more of these elements.

Kwon discloses a method of improving superconducting properties of selected (Rare Earth)$Ba_2Cu_3O_7$ layers by adding a thin buffer layer (column 4, lines 37+). The rate formation of the thin films or layers can be varied from about 0.01 nm/s to about 20 nm/s (column 4, lines 25+), but no differentiation is made between the growth rates of the two layers. *Kwon* has not been found to include even a hint that a thick superconducting $XBa_2Cu_3O_7$-layer of good quality (high T_c and high current density) could be deposited with a high growth rate after a thin $RBa_2Cu_3O_7$-layer has been grown very slowly on the substrate.

Recognizing this fundamental deficiency of *Kwon* vis-a-vis claim 1, the Examiner turns to *Groves*. *Groves*, however, relates to materials and processes different from those of *Kwon*.

More particularly, *Groves* describes a process which allows a deposition of different buffer layers between a polycrystalline metal substrate and a YBCO superconducting layer. After the formation of a thin nucleation layer (about 5 nm) on the substrate, a MgO layer is deposited using a DIBAD process (dual ion beam assisted deposition) (cf. column 4, line 24). On the MgO layer one or two thin buffer layers (about 20 nm) of yttrium or YSZ (yttrium stabilized zirconium oxide) are slowly formed (0.05 nm/s) using a PLD process (pulse layer deposition). On this or these buffer layer(s) the YBCO layer is rather rapidly (2 nm/s) deposited using again PLD (cf. column 6, line 11).

Thus, Groves discloses a hetero-epitaxy process for the formation of an adaptation structure between the superconducting YBCO and the oriented MgO buffer

layer, which is different from *Kwon* which involves a homo-epitaxy process. The adaptation of the crystallographic structure of the YBCO layer to the oriented MgO buffer layer is achieved by different layers of different materials, and not by a slowly deposited YBCO buffer layer. Additionally, *Kwon* applies two different deposition techniques (DIDBAD and PLD) for the deposition of the different buffer layers.

The skilled person would readily appreciate the growth rates for the buffer layers given in *Groves* are process-related (reactive sputtering). The skilled person would also know that deposition rates are parameters strongly depending on individual materials that cannot simply be transferred to other material systems since the formation of a crystallographic structure depends strongly on its chemical composition, the masses of the involved elements, diffusion lengths and temperatures. The Examiner's attempt to transfer the use of different deposition rates for different materials to the deposition of identical or similar materials is driven by impermissible hindsight.

Consequently, *Groves* provides no reasonable basis for the skilled person to modify *Kwon* in a manner giving rise to the subject matter of the claims. Therefore, the rejection based on *Kwon* and *Groves* should be reversed.

<u>Claim 2</u>

Claim 2 depends from claim 1 and specifies the high growth rate is greater than 2 nm/s.

Kwon discloses growth rates for both layers of about 0.1 Angstrom per second to about 200 Angstrom per second (0.01 to 20 nm/s) (column 4, lines 25-28). Thus, if a

skilled person wanted to practice the method of *Kwon* at a growth rate greater than 2 nm/s, he or she would simply grow both layers at the same rate. Nothing in *Kwon* has been found to suggest any undesirability of doing so. Thus, for this additional reason, there is lacking any reasonable basis to look elsewhere to attain higher growth rates. Even if there was some reasonable basis, the skilled person would not have looked to *Groves* because of the different materials and film thicknesses, and the different deposition techniques involved.

Claim 6

Claim 6 depends from claim 1 and specifies the $RBa_2Cu_3O_7$-layer is deposited onto an at least biaxially textured substrate or a substrate with an at least biaxially textured buffer layer.

The Examiner's statement of the rejection does not address this feature and thus does not set forth a *prima facie* case of obviousness. That is, the Examiner has not explained how the combination he is advancing renders obvious the feature of claim 6.

Claim 7

Claim 7 depends from claim 1 and specifies the $XBa_2Cu_3O_7$-layer is deposited as a precursor layer, comprising the metal components of the high temperature superconducting layer.

The Examiner's statement of the rejection does not address this feature and thus does not set forth a *prima facie* case of obviousness. That is, the Examiner has not explained how the combination he is advancing renders obvious the feature of claim 7.

Claim 8

Claim 8 depends from claim 7 and specifies the precursor layer is transformed in a further method step by a temperature treatment with a high transformation rate into a superconducting $XBa_2Cu_3O_7$-layer.

The Examiner's statement of the rejection does not address this feature and thus does not set forth a *prima facie* case of obviousness. That is, the Examiner has not explained how the combination he is advancing renders obvious the feature of claim 8.

Claim 9

Claim 9 depends from claim 8 and specifies the transformation rate is greater than 2 nm/s.

The Examiner's statement of the rejection does not address this feature and thus does not set forth a *prima facie* case of obviousness. That is, the Examiner has not explained how the combination he is advancing renders obvious the feature of claim 9.

A2. Rejection of Claims 1-10 (*Kwon* with *Nagaishi* and *Groves*)

Claims 1-10 stand finally rejected under 35 U.S.C. § 103(a) as being unpatentable over *Kwon* in view of *Nagaishi* and *Groves*. The Examiner's remarks in support of the rejection are as follows:

> (b) Nagaishi et al. (5,248,649) teaches a process for preparing a superconducting thin oxide. Nagaishi et al. (5,248,649) teaches the pulsed rate of the pulsed laser beam is adjusted between 0.1- 10 HZ and the application is interrupted at each time the superconductor is grown at a growth rate of 0.5 A/s (abstract). Nagaishi et al. (5,248,649) teaches that the quality of the resulting film can generally be improved by slowing down the growth rate within a certain range (col. 2, lines 55-65).
>
> Nagaishi et al. (5,248,649) or Himtermaier et al. (6,177,135) fail to teach the claimed growth rates of less than 1 nm/s and greater than 1 nm/s.
>
> Groves et al. (6,899,928) teaches depositing buffer layers and YBCO layers. The buffer layers are applied with a growth rate of 0.5 nm/s followed by the YBCO layer having a growth rate of 2.0 nm/s to obtain improved lattice matching with the final YBCO layer(col. 6, lines 4-18).
>
> Therefore it would have been obvious for one skilled in the art at the time the invention was made to have modified Kwon et al. (6,943,136) process by slowing down deposition of the superconducting buffer layer as evidenced by Nagaishi et al. (5,248,649) or Himtermaier et al. (6,177,135) having the growth rate of Groves et al. (6,899,928) with the expectation of achieving a higher quality buffer film which would in turn produce a higher quality superconducting film thereon based upon the crystallographic structure of the buffer film being continued throughout the superconducting layer.

Claim 1

Nagaishi discloses a method for preparing a high-quality thin superconducting film of a Bi-Sr-Ca-Cu-O. According to *Nagaishi* the quality of this type of super-conducting layer can be improved by reducing its growth rate (0.05 nm/s) (column 2, lines 55+). The material composition of the superconducting film in *Nagaishi* is different from that set forth in *Kwon*, and the Examiner provides no explanation as to why one of ordinary skill in the art would be reasonably justified in modifying *Kwon* in view of *Nagaishi* as suggested by the Examiner.

Moreover, *Nagaishi* has not been found to include even a hint that a second layer could be grown on the slowly grown first layer with a higher deposition rate and still yield a good quality. There has not been found even an indication that a second layer is foreseen in *Nagaishi*.

The addition of *Groves* does not overcome the fundamental deficiencies of *Kwon* and *Nagaishi*. *Groves* provides no reasonable basis for the skilled person to modify *Kwon* and/or *Nagaishi* in a manner giving rise to the subject matter of the claims. Therefore, the rejection based on *Kwon*, *Nagaishi* and *Groves* should be reversed.

Claim 2

Claim 2 depends from claim 1 and specifies the high growth rate is greater than 2 nm/s.

Kwon discloses growth rates for both layers of about 0.1 Angstrom per second to about 200 Angstrom per second (0.01 to 20 nm/s) (column 4, lines 25-28). Thus, if a skilled person wanted to practice the method of *Kwon* at a growth rate greater than 2 nm/s, he or she would simply grow both layers at the same rate. Nothing in *Kwon* has been found to suggest any undesirability of doing so. Thus, for this additional reason, there is lacking any reasonable basis to look elsewhere to attain higher growth rates. Even if there was some reasonable basis, the skilled person would not have looked to *Nagaishi* and *Groves* because of the different materials.

Claim 6

Claim 6 depends from claim 1 and specifies the $RBa_2Cu_3O_7$-layer is deposited onto an at least biaxially textured substrate or a substrate with an at least biaxially textured buffer layer.

The Examiner's statement of the rejection does not address this feature and thus does not set forth a *prima facie* case of obviousness. That is, the Examiner has not explained how the combination he is advancing renders obvious the feature of claim 6.

Claim 7

Claim 7 depends from claim 1 and specifies the $XBa_2Cu_3O_7$-layer is deposited as a precursor layer, comprising the metal components of the high temperature superconducting layer.

The Examiner's statement of the rejection does not address this feature and thus does not set forth a *prima facie* case of obviousness. That is, the Examiner has not explained how the combination he is advancing renders obvious the feature of claim 7.

<u>Claim 8</u>

Claim 8 depends from claim 7 and specifies the precursor layer is transformed in a further method step by a temperature treatment with a high transformation rate into a superconducting $XBa_2Cu_3O_7$-layer.

The Examiner's statement of the rejection does not address this feature and thus does not set forth a *prima facie* case of obviousness. That is, the Examiner has not explained how the combination he is advancing renders obvious the feature of claim 8.

<u>Claim 9</u>

Claim 9 depends from claim 8 and specifies the transformation rate is greater than 2 nm/s.

The Examiner's statement of the rejection does not address this feature and thus does not set forth a *prima facie* case of obviousness. That is, the Examiner has not explained how the combination he is advancing renders obvious the feature of claim 9.

A3. Rejection of Claim 1-10 (Kwon with *Hintermaier* and *Groves*)

Claims 1-10 stand finally rejected under 35 U.S.C. § 103(a) as being unpatentable over *Kwon* in view of *Hintermaier* and *Groves*. The remarks given in

support of the rejection are similar to those set out above under Section A2, except the Examiner characterizes *Hintermaier* as follows:

> Hintermaier et al. (6,177,135) teaches that it would be helpful to have a lower growth rate for a nucleation layer and then increasing the growth rate for the second deposition step as this would facilitate compositional growth that depends upon the surface to which the coating is applied (col. 10, lines 17-30).

Claim 1

Hintermaier describes a CVD process (chemical vapor deposition) to deposit a ferroelectric film on a substrate. The film comprises of SBT (strontium bismuth tantalate, $SrBi_2TaO_9$) (cf. column 1, line 55) and is being used in nonvolatile memories (cf. column 1, line 35). *Hintermaier* explains that a CVD process can be carried out under different conditions. It may be helpful to have a nucleation control in the beginning, even if this decreases the growth rate. After the nucleation step, the conditions are changed for a high growth rate (cf. column 10, line 23).

Hintermaier, however, has not been found to deal at all with a superconducting material. Consequently, there is lacking any reasonable basis for the skilled person to look to *Hintermaier* on how to improve the process of *Kwon*. There simply would be no reasonable expectation that modifying *Kwon* in view of *Hintermaier* as contended by the Examiner would result in a high quality superconducting layer.

The addition of *Groves* does not overcome the fundamental deficiencies of *Kwon* and *Hintermaier*. Groves provides no reasonable basis for the skilled person to modify

Kwon and/or *Hintermaier* in a manner giving rise to the subject matter of the claims. Therefore, the rejection based on *Kwon*, *Hintermaier* and *Groves* should be reversed.

Claim 2

Claim 2 depends from claim 1 and specifies the high growth rate is greater than 2 nm/s.

Kwon discloses growth rates for both layers of about 0.1 Angstrom per second to about 200 Angstrom per second (0.01 to 20 nm/s) (column 4, lines 25-28). Thus, if a skilled person wanted to practice the method of *Kwon* at a growth rate greater than 2 nm/s, he or she would simply grow both layers at the same rate. Nothing in *Kwon* has been found to suggest any undesirability of doing so. Thus, for this additional reason, there is lacking any reasonable basis to look elsewhere to attain higher growth rates. Even if there was some reasonable basis, the skilled person would not have looked to *Hintermaier* and *Groves* because of the different materials.

Claim 6

Claim 6 depends from claim 1 and specifies the $RBa_2Cu_3O_7$-layer is deposited onto an at least biaxially textured substrate or a substrate with an at least biaxially textured buffer layer.

The Examiner's statement of the rejection does not address this feature and thus does not set forth a *prima facie* case of obviousness. That is, the Examiner has not explained how the combination he is advancing renders obvious the feature of claim 6.

Claim 7

Claim 7 depends from claim 1 and specifies the $XBa_2Cu_3O_7$-layer is deposited as a precursor layer, comprising the metal components of the high temperature superconducting layer.

The Examiner's statement of the rejection does not address this feature and thus does not set forth a *prima facie* case of obviousness. That is, the Examiner has not explained how the combination he is advancing renders obvious the feature of claim 7.

Claim 8

Claim 8 depends from claim 7 and specifies the precursor layer is transformed in a further method step by a temperature treatment with a high transformation rate into a superconducting $XBa_2Cu_3O_7$-layer.

The Examiner's statement of the rejection does not address this feature and thus does not set forth a *prima facie* case of obviousness. That is, the Examiner has not explained how the combination he is advancing renders obvious the feature of claim 8.

Claim 9

Claim 9 depends from claim 8 and specifies the transformation rate is greater than 2 nm/s.

The Examiner's statement of the rejection does not address this feature and thus does not set forth a *prima facie* case of obviousness. That is, the Examiner has not explained how the combination he is advancing renders obvious the feature of claim 9.

VIII. Conclusion

In view of the foregoing, it is respectfully submitted that the claims are patentable over the applied art and that the rejections advance by the Examiner should be reversed.

Respectfully submitted,

RENNER, OTTO, BOISSELLE & SKLAR, L.L.P.

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Claims Appendix

1. A method for the manufacture of a high temperature superconducting layer on a substrate comprising the following steps:

   a. deposition of an $RBa_2Cu_3O_7$-layer onto the substrate with a low growth rate less than 1 nm/s, wherein R represents yttrium, an element of the group of rare-earth elements (atomic number 57-71) or mixtures of two or more of these elements;
   b. deposition of an $XBa_2Cu_3O_7$-layer onto the $RBa_2Cu_3O_7$-layer with a high growth rate greater than 1 nm/s, wherein X represents yttrium, an element of the group of rare-earth elements (atomic number 57-71) or mixtures of two or more of these elements.

2. A method according to claim 1, wherein the high growth rate is greater than 2 nm/s.

3. A method according to claim 1, wherein the $RBa_2Cu_3O_7$-layer comprises a thickness of less than 500 nm.

4. A method according to claim 1, wherein the $RBa_2Cu_3O_7$-layer has a thickness of greater than 5 nm.

5. (previously presented) A method according to claim 1, wherein the $XBa_2Cu_3O_7$-layer has a thickness of greater than 1 µm.

6. A method according to claim 1, wherein the $RBa_2Cu_3O_7$-layer is deposited onto an at least biaxially textured substrate or a substrate with an at least biaxially textured buffer layer.

7. A method according to claim 1, wherein the $XBa_2Cu_3O_7$-layer is deposited as a precursor layer, comprising the metal components of the high temperature superconducting layer.

8. A method according to claim 7, wherein the precursor layer is transformed in a further method step by a temperature treatment with a high transformation rate into a superconducting $XBa_2Cu_3O_7$-layer.

9. A method according to claim 8, wherein the transformation rate is greater than 2 nm/s.

10. A method according to claim 1, wherein R represents a rare-earth element of the group comprising La, Pr, Nd, Sm, Eu, and Gd, or compounds comprising to at least 50% of one or more of these elements in mixtures with other rare-earth elements.

Evidence Appendix

None.

Related Proceedings Appendix

None.